

## CLAIMS:

What is claimed is:

1. A method for performing OTDM, said method comprising the following steps:

5 a) generating  $n$  bit streams of approximately  $B$  Gb/s from respectively  $n$  tunable laser beams having respectively wavelengths of  $\lambda_1, \lambda_2, \dots$  and  $\lambda_n$ ;

b) generating from said  $n$  bit streams  $n$  group velocity dispersed bit streams by introducing group velocity dispersion into said  $n$  bit streams;

10 c) combining said  $n$  group velocity dispersed bit streams into a composite bit stream of approximately  $nB$  Gb/s; and

d) in response to misalignment of bits within said composite bit stream, tuning said  $\lambda_1, \lambda_2, \dots$  and  $\lambda_n$  to create the proper OTDM time differential between consecutive bits within said composite bit stream.

15 2. The method of Claim 1, further comprising the following steps:

e) generating a single-wavelength composite bit stream of approximately wavelength  $\lambda_v$  and  $nB$  Gb/s by operating on said composite bit stream with a wavelength converter; and

20 f) in response to misalignment of bits within said single-wavelength composite bit stream, tuning said  $\lambda_1, \lambda_2, \dots$  and  $\lambda_n$  to create the proper OTDM time differential between consecutive bits within said single-wavelength composite bit stream.

3. An OTDM transmitter, comprising:

a)  $n$  channels of bit streams  $D_1, D_2, \dots$  and  $D_n$  having respectively wavelengths of  $\lambda_1, \lambda_2, \dots$  and  $\lambda_n$ , wherein for  $j = 1$  to  $n$ , the  $j$ -th channel comprises:

j1) a tunable laser source  $S_j$  providing a bit stream  $B_j$  of approximately  $B$  Gb/s; and

5 j2) a group velocity dispersive element  $E_j$  coupled to said  $S_j$ , introducing group velocity dispersion into said  $B_j$  to generate said  $D_j$ ;

b) a combiner coupled to said  $n$  channels and adapted to optically combine said  $D_1, D_2, \dots$  and  $D_n$  into a composite bit stream of approximately  $nB$  Gb/s; and

c) a wavelength converter coupled to said combiner and adapted to convert said  
10 composite bit stream into a single-wavelength composite bit stream of approximately  $nB$  Gb/s to be transmitted through an optical link, wherein OTDM time differential can be created between consecutive bits of said single-wavelength composite bit stream by tuning  $\lambda_1, \lambda_2, \dots$  and  $\lambda_n$ .

15 4. A method for performing OTDM transmission, said method comprising the steps of:

a) generating  $n$  bit streams of approximately  $B$  Gb/s from respectively  $n$  tunable laser beams having respectively initial wavelengths of  $\lambda_1, \lambda_2, \dots$  and  $\lambda_n$ ;

b) generating  $n$  group velocity dispersed bit streams by introducing group velocity  
20 dispersion into said  $n$  bit streams;

c) combining said  $n$  group velocity dispersed bit streams into a composite bit stream of approximately  $nB$  Gb/s;

d) generating a single-wavelength composite bit stream of wavelength  $\lambda_v$  by wavelength converting said composite bit stream with a wavelength converter;

e) in response to misalignment of bits within said single-wavelength composite bit stream, tuning said  $\lambda_1, \lambda_2, \dots$  and  $\lambda_n$  to create the proper OTDM time differential between consecutive bits within said single-wavelength composite bit stream; and

f) transmitting said single-wavelength composite bit stream by launching said single-wavelength composite bit stream into an optical transmission link.

5. A WDM system, comprising:

a) m OTDM channels, wherein for  $k = 1$  to m, the k-th OTDM channel comprises:

k1) n channels  $V_{k1}, V_{k2}, \dots$  and  $V_{kn}$  providing respectively bit streams  $D_{k1}, D_{k2}, \dots$  and  $D_{kn}$  having respectively wavelengths of  $\lambda_{k1}, \lambda_{k2}, \dots$  and  $\lambda_{kn}$ , wherein for  $j = 1$  to n, the j-th channel  $V_{kj}$  comprises:

kj1) a tunable laser source  $S_{kj}$  providing a bit stream  $B_{kj}$  of approximately B Gb/s; and

kj2) a group velocity dispersive element  $E_{kj}$  coupled to said  $S_{kj}$ , introducing group velocity dispersion into said  $B_{kj}$  to generate said  $D_{kj}$ ;

k2) a combiner coupled to said n channels and adapted to optically combine said n bit streams into a composite bit stream  $U_k$ ;

k3) a wavelength converter coupled to said combiner and adapted to convert said composite bit stream into a single-wavelength composite bit stream  $A_k$  of

wavelength  $\lambda_{vk}$ , wherein the proper OTDM time differential can be created between consecutive bits of said  $A_k$  by tuning  $\lambda_{k1}$ ,  $\lambda_{k2}$ , ... and  $\lambda_{kn}$ ; and

b) a WDM multiplexer coupled to said  $m$  OTDM channels, with said WDM multiplexer adapted to generate a composite optical signal with a data rate of approximately  $mnB$  Gb/s.

6. An OTDM subsystem for performing optical time-division-multiplexing, said OTDM subsystem comprising:

a)  $n$  channels of bit streams  $D_1$ ,  $D_2$ , ... and  $D_n$  having respectively wavelengths of  $\lambda_1$ ,  $\lambda_2$ , ... and  $\lambda_n$ , wherein for  $j = 1$  to  $n$ , the  $j$ -th channel comprises:

j1) a tunable laser source  $S_j$  providing a bit stream  $B_j$  of approximately  $B$  Gb/s; and

j2) a group velocity dispersive element  $E_j$  coupled to said  $S_j$ , introducing group velocity dispersion into said  $B_j$  to generate said  $D_j$ ;

b) a combiner coupled to said  $N$  channels and adapted to optically combine said  $D_1$ ,  $D_2$ , .... and  $D_n$  into a composite bit stream of approximately  $nB$  Gb/s, wherein OTDM time differential can be created between consecutive bits of said composite bit stream by tuning  $\lambda_1$ ,  $\lambda_2$ , ... and  $\lambda_n$ .

7. The Claims of 2-6, wherein return-to-zero (RZ) format is used in generating bit streams.

8. The Claims of 2-6, wherein said  $B$  Gb/s is 10 Gb/s, and wherein said  $n$  is 4.

9. The Claims of 2-6, wherein said B Gb/s is 40 Gb/s, and wherein said n is 4.

10. The Claims of 2-5, wherein said wavelength converter is a vertical lasing semiconductor optical amplifier (VLSOA), and wherein said single wavelength is generated  
5 from the vertical lasing of said VLSOA.

11. The Claims of 2-5, wherein said wavelength converter uses four-wave mixing.

12. The Claims of 2-5, wherein said wavelength converter is a MZ-SOA.

13. The Claims of 2-5, wherein said wavelength converter is a SOA.

14. The method of Claim 1, wherein said n bit streams are generated by modulating respectively n CW tunable laser sources.

15. The method of Claim 1, wherein said n bit streams are generated respectively by n directly modulated tunable laser sources.

16. The OTDM transmitter of Claim 3, wherein for said  $j=1$  to n, said  $S_j$  in said j-th channel is a CW tunable laser that is coupled to a modulator  $M_j$ , said  $M_j$  modulating a  
20 laser beam  $L_j$  generated by said  $S_j$  into said  $B_j$ .

17. The OTDM transmitter of Claim 3, wherein for said  $j=1$  to  $n$ , said  $S_j$  in said  $j$ -th channel is a tunable laser that is directly modulated.

18. The method of Claim 4, wherein said  $n$  bit streams are generated by  
5 modulating respectively  $n$  CW tunable laser sources.

19. The method of Claim 4, wherein said  $n$  bit streams are generated respectively by  $n$  directly modulated tunable laser sources.

10 20. The WDM system of Claim 5, wherein for  $k=1$  to  $m$  and  $j = 1$  to  $n$ , said tunable laser source  $S_{kj}$  in said  $j$ -th channel  $V_{kj}$  is a tunable CW laser source that is coupled to a modulator  $M_{kj}$ , said  $M_{kj}$  modulating a laser beam  $L_{kj}$  produced from said  $S_{kj}$  into said stream  $B_{kj}$ .

15 21. The WDM system of Claim 5, wherein for  $k=1$  to  $m$  and  $j = 1$  to  $n$ , said tunable laser source  $S_{kj}$  in said  $j$ -th channel  $V_{kj}$  is a tunable laser that is directly modulated.

22. The OTDM subsystem of Claim 6, wherein for said  $j=1$  to  $n$ , said  $S_j$  in said  $j$ -th channel is a CW tunable laser that is coupled to a modulator  $M_j$ , said  $M_j$  modulating a  
20 laser beam  $L_j$  generated by said  $S_j$  into said  $B_j$ .

23. The OTDM subsystem of Claim 6, wherein for said  $j=1$  to  $n$ , said  $S_j$  in said  $j$ -th channel is a tunable laser that is directly modulated.